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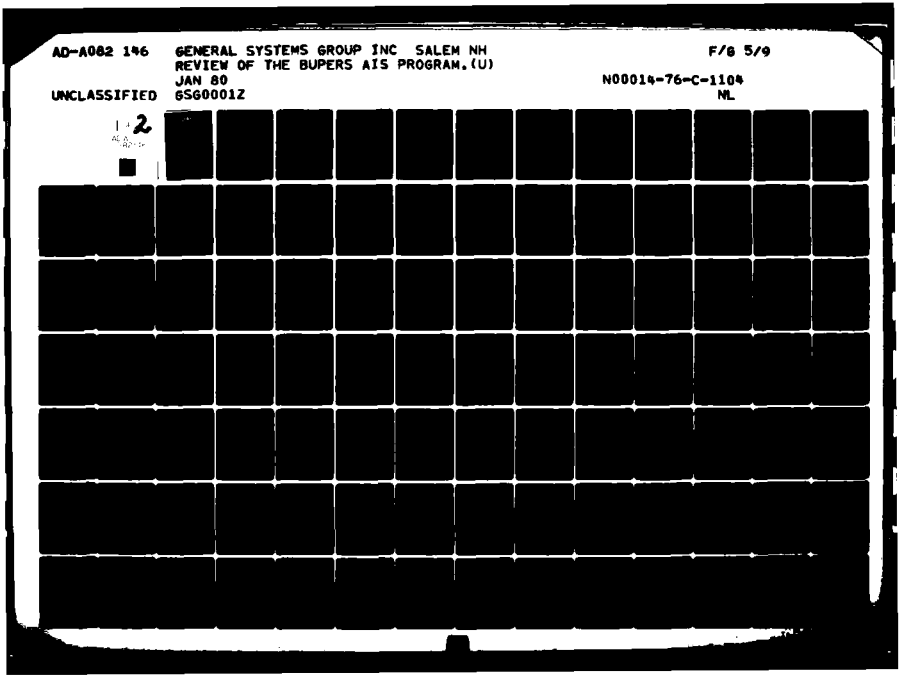

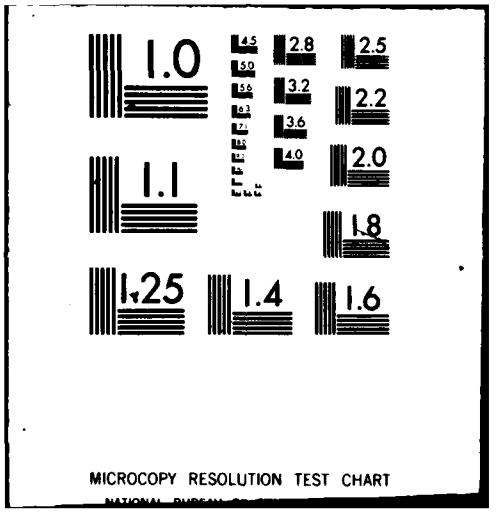
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Final Report

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By

General Systems Group, Inc.

January 31, 1980

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Reviews of the Bupers AIS Program

Advanced Information System

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objective of the program was to assist the Bureau of Naval Personnel in their development of the Advanced Information System (AIS).

(Continued on next page)

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Briefly stated the goals of the AIS plan are to introduce in the operational systems of the Bureau the following modern data processing technologies:

- Integrated database management,
- Structured programming,
- Development environments that improve the portability of system software,
- Virtual machines and data abstraction techniques in support of architectural design.

Concurrent with the introduction of these software technologies, AIS is aimed at greatly expanding the access to computer resources by the clerical staffs of the Bureau.

The ultimate significance of the AIS development rests on accelerating and streamling a number of personnel assignment (distribution), training, selection, etc. functions as well as providing better support of manpower and planning activities.

GSG's activities during the contract period consisted in a number of reviews. Each review considered research, architectural design, software engineering, development management and procurement issues.

The first review is concerned with a very interesting applied research program underway at Randolph AFB by the Military Personnel Center (MPC) of the Air Force.

The second major review is an in-depth program review of the entire AIS program at Bupers.

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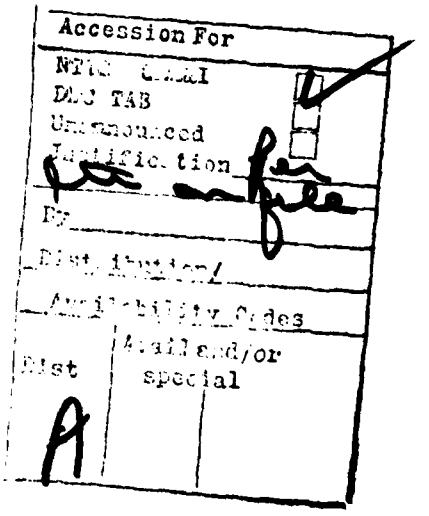

1.0 Introduction

In this final report for Contract No. N00014-76-C-1104 we will document the major technical activities of the program.

The objective of the program was to assist the Bureau of Naval Personnel in their development of the Advanced Information System (AIS).

Briefly stated the goals of the AIS plan are to introduce in the operational systems of the Bureau the following modern data processing technologies:

- Integrated database management
- Structured programming
- Development environments that improve the portability of system software
- Virtual machines and data abstraction techniques in support of architectural design

Concurrent with the introduction of these software technologies AIS is aimed at greatly expanding the access to computer resources by the clerical staffs of the Bureau.

The four major software technologies mentioned above are strong contributors to generating software that can be modified with greater ease than traditional software. Thus their employment will benefit the users by allowing a more rapid tracking of the user's evolving requirements.

The enhanced access by the clerical staff will result from the adoption of an on-line plus batch philosophy of processing coupled with a wide dispersal of suitable terminals in the offices of the Bureau.

AIS is an incremental development, that is, facilities are being brought on-line by discrete increments.

Some of these increments are already operational and enjoying great success (for instance the PRO system, see Appendix B).

The ultimate significance of the AIS development rests on accelerating and streamling a number of personnel assignment (distribution), training, selection, etc. functions as well as providing better support of manpower and planning activities.

Simultaneously, the AIS development is acting as a catalyst for the integration of manpower/training/personnel processes for the following categories of labor:

- Military
- Civilian
- Reserve
- Contractors

At a time when better than half of the defense dollar is spent on personnel AIS promises to be an inexpensive investment in improving the effectiveness of the Navy.

GSG's activities during the contract period consisted in a number of reviews. Each review considered research, architectural design, software engineering, development management and procurement issues.

This broad spectrum of issues was convered by the use of teams of people with the various expertises listed above.

In this final report we will document the two most important reviews during the contract year.

The first review is concerned with a very interesting applied research program underway at Randolph AFB by the Military Personnel Center (MPC) of the Air Force.

The review technical findings are summarized in Section 2.0 of this report. Appendix A of this report is the original GSG report on the review.

The second major review is an in-depth program review of the entire AIS program at Bupers. Again, the technical findings of this review are summarized in Section 3.0 of this report. Appendix B of this report is the original GSG report on the review.

2.0 The Personnel Machine

The basic notion behind the personnel machine is to maintain and enlarge the previous thrusts of systems such as BLPS and HAF core in the direction of a highly responsive flexible system design for personnel applications. This is viewed as achievable via the integration of a number of technologies which did not exist at the time that BLPS and HAF were first designed and implemented. The specific technologies whose integration is contemplated are:

1. Modern system implementation programming languages, namely the technology of transportable software for system level software, as reflected by such languages as PASCAL and ADA (which is PASCAL based).

2. The technology, that has evolved over the last decade, of modularization and stratification of operating systems, namely the generalization of the virtual machine notions.

3. The integrated database technology, whose major significance is the more complete separation of data and procedures and the ability to represent complex relationships amongst data in a program or procedure independent way.

4. The decision logic table technology for application programming.

5. The integration of certain key aspects of the system programming technology with the database technology.

Let's briefly review these five items to see what they mean. Item 1 really represents the adoption of a body of recent Computer Sciences research on the necessary and sufficient characteristics of programming languages to allow the transportability of system software. By and large, this body of notions has not entered yet the common industrial practice which still rests largely on the use of assembly languages for system software. It is also clear that the long term trend is that these technologies will indeed be used on a wide basis.

Point 2 (the stratification of the OS) represents technology which has entered industrial practice quite extensively, this project is recommending that in addition to what are well accepted points about the stratification of the inner layers of the operating system that a special "personnel oriented" layer be constructed. This certainly is a good recommendation. Its implementation represents a novel effort since it requires the proper identification of a set of complete and possibly minimal personnel primitives.

Point 3 again has entered the industrial practice, in the sense that many current systems use integrated data base technologies. The project is indicating a commitment to the use of relational database technology, common industrial practice is still based on the use of hierarchical and network database technology, however, by and large, this technology is well into practice. The Air Force personnel systems are behind the times by not having adopted it sooner.

Point 4, namely the extensive use of decision logic table technology for the definition of the application program procedures, is the point in which the Air Force personnel experience has led the way with respect to industrial practice. In fact, one of the major distinguishing characteristics of BLPS, which is basically a predecessor to HAF, was its strong commitment to the use of DLT's for the definition of procedures such as edits. The use of decision logic tables increases considerably the ability to modify procedures rapidly and efficiently, and the ability of the non-programming skilled personnel to bring about such modifications or to understand the modifications made by somebody else. MPC trailblazed the practical application of DLT's over a decade ago.

In view of this successful experience it is correct to integrate it in the new research. In particular, the DLT's are not inconsistent with any of the other notions above so we do not see any problems with factoring this into the overall plan.

Point 5 is where the project shows, in our opinion, the greatest amount of technological innovation, in fact the state-of-the-art is that notions of datatyping and data description, which are particular to the modern programming languages, such as PASCAL, have not really been related with similar notions in database data management technology. Point 5 is precisely the integration of these similar but yet distinct notions. In other words, in this area we believe that the project will actually do a certain amount of applied research and tackling of not fully understood or fully known issues. However, we are confident that this is a necessary and potentially very useful integration to accomplish.

To better understand the significance of integrating the four technologies listed above it is well to remember the nature of the fundamental architectural tradeoff. This tradeoff is a tradeoff between the modifiability of the system and its efficient use of computer resources. In general, choices can be made either in the direction of increasing computer resources utilization or in the direction of increasing the ease with which the system can be modified, adapted, expanded, etc., but not both simultaneously.

The history of computer technology can be viewed as a progression towards increasingly favoring the modifiability aspect over the efficiency aspect. The reason why computer

technology has been moving in this direction are: a) the rapidly decreasing costs of computer resources warrants less and less preoccupation with their efficient utilization, b) the advance of Computer Science has improved the understanding of a number of modularity concepts, that while having a price in terms of efficient use of computer resources, greatly simplify the process of building a system, and consequently modifying it too, c) there has been a growing realization that EDP is not an end to itself, but it is a service function and consequently, from an economic point of view, one should be concerned not with the efficient utilization of computer resources, but rather with the efficient utilization of the operational resources.

The reason why we are mentioning this basic notion of computer technology is that the four technologies, mentioned above, and their integration move in the direction of increasing modularity and consequently modifiability, extendability, adaptability of the computing system. They all have built in some costs in terms of efficiency of computer resources. So, that to say that one would undertake a radical reorientation of the system design along the lines mentioned above means that one is seeking a very significant increase of modifiability, adaptability, and expandability of the system at the expense of some reduction of computer resource utilization. We believe that this is indeed the right direction to go, especially in systems designed for personnel functions.

Another historical perspective, that is worth keeping in mind in evaluating this special project, is that the application of computers started with the mechanization of accounting and cost control applications, where the field of applications is much less variable and dynamic than personnel. Later computer applications went into the personnel area. There is a fundamental difference between the personnel applications and say the accounting applications. Consider, for example, the case of legislative (mandated) changes to the EDP system. In the case of accounting systems changes to accounting rules or accounting policy are rare and therefore, they materialize at intervals which are long enough to accomodate ponderous change mechanisms. In the case of personnel, mandated changes are very very frequent, especially in the last few years there has been a veritable explosion of legislation in the area of personnel benefits, taxes, retirement policies, etc. It is thus very clear that personnel systems should be designed with a system philosophy which is different than that for accounting systems. This was recognized by MPC even at the time of BLPS and HAF, and the special project is simply further accentuating such a trend.

3.0 AIS Review: Technical Issues

The operational experience accumulated thus far with the PRO system allows an evaluation of the PRO architecture. This evaluation was presented to us during the review and basically the results are that the PRO distributed architecture succeeds very well in off-loading the central processor. In fact, a considerable number of terminals can be supported with absolutely negligible loading of the central processor. However, while from a performance point of view, the PRO architecture has proved out to be very effective there are serious misgivings with regard to its availability.

During the presentation there was considerable discussion on whether the availability problem arises from the Host, or the FEP, or the remote terminal processor, or the lines. As a result of the discussions we requested that some actual data be given to us with regard to scheduled time, available time, and down time for the three classes of processors namely Host, FEP, RTPC.

The data covers the four weeks of November 13, November 20, November 27, and December 4, and they are presented in Table 3-1.

	Scheduled Uptime	Host Available	Host Down	FEP Available	FEP Down	Mini RTPC Available	Mini RTPC Down
13NOV78	45.0	31.0	14.0	44.9	0.1	41.6	3.4
20NOV78	36.0	24.6	11.4	35.1	0.9	34.9	1.1
27NOV78	45.0	34.0	11.0	44.8	0.2	44.0	1.0
04DEC78	45.0	29.0	16.0	43.4	1.6	44.3	0.7
Totals	171.0	118.6	52.4	168.2	2.8	164.8	6.2
PERCENTAGE Scheduled Uptime ÷	100	69.3	30.6	98.3	1.7	96.3	3.6

Table 3-1

The data is extremely significant and again illustrates that a little bit of data can cut through endless hours of discussion. In fact, the data shows that the host was available during those four weeks for an average of 69.3% of scheduled time, the FEP was available during the same period for an average of 98.3% of scheduled time, and the RTPC was available over the same period for an average of 96.3% of scheduled time. From these figures it can be readily concluded that the lack of availability of PRO to the user is largely determined, if not exclusively determined, by the fact that the Host is down something like 30.6% of scheduled time. Therefore, the availability of PRO is not the consequence of its architecture.

Our recommendation is thus to carry an in-depth study of the causes of such an excessive down time for the Host. We also recommend that a management objective of gradually reducing the Host down time be set up. In addition, consideration should be given to increasing the amount of scheduled time so that overall user availability can be improved.

An important architectural issue is what should be the implementation language for the future of AIS. During the presentations of the CORE systems program the issue of implementation was raised, namely the desirability to have high level language alternatives to the use of assembly language (ALC).

Our recommendation in this area would be that, provided that the speed of compilation is not extremely crucial, and that on the other hand efficient object code is an important issue, AIS establish contact with various research groups in the country who are experienced with PASCAL and PASCAL transportability and bootstrapping mechanisms. We can assist AIS personnel in establishing these contacts.

The rationale for this recommendation is as follows:

a) We believe that the ADA initiative will succeed (over a number of years). ADA is PASCAL derived, consequently a move towards PASCAL would be a staging move for an eventual adoption of ADA by AIS.

b) Programming languages of modern type such as PASCAL, ADA provide the tools for producing software which is not only structured but is also designed for modern notions of portability.

c) There are already a number of PASCAL compilers which are written in PASCAL therefore suitable for bootstrapping the compiler onto one's own machine.

The most important issue for the CORE systems area is that of the development strategy to be pursued in light of the Brand X procurement. Assuming the Brand X will proceed on the present course of a totally A-109 procurement, the

planning of developments in the CORE system area is both very difficult and very critical to the success of the Brand X operation.

From the review we learned that an effort to formulate a CORE system design concept is presently underway. One of the very first questions is: to what use would such a design concept be put. The possible uses as we see them are:

a) As a blueprint for internal development to be pursued once the Brand X machine is available.

b) As a specification for the Brand X procurement.

c) As a means to supply in-depth technical evaluation material to be used during the Brand X proposal selection phase.

d) As a blueprint for development to be performed after Brand X is known by either the original Brand X vendor or other contractors.

e) As a blueprint for both staging activities to be performed before the Brand X selection, and developments after the Brand X selection, by OP-16 people augmented by contractors.

It seems to us that alternative a) is largely to be excluded because the limited development resources are already completely applied to short term development goals.

Alternative b) has to be excluded because it is contrary to the spirit and the letter of A-109. Alternative c), d), and e) are all of significant interest.

In the case of alternative c) the design concept for CORE systems could be a source of technical evaluation factors with great power of discrimination and selectivity. Since there is no question that after Brand X has been selected the evolution of CORE systems will have to continue, it follows that alternative d) will be of interest in guiding the further work of the Brand X vendor and associated contractors. However, the most interesting use of a design concept for CORE systems is really alternative e). This alternative really contemplates staging activities that could be performed before the Brand X is installed.

What we are referring to is that, while for the application systems the Brand X procurement concept will guarantee that they will transition correctly to Brand X, nothing of the kind is available for CORE systems.

Furthermore, to insist that a transition benchmark be used for CORE system as well as application systems could be construed as being contrary to predominant procurement doctrine and A-109. The reason why CORE systems cannot be incorporated in a transition benchmark is that it is very difficult, if not impossible to assert that CORE system functionality is directly related to mission requirements.

Since CORE systems cannot be incorporated in transition benchmark, the alternative is to stage the CORE systems so that equivalent functionality can be guaranteed after the transition.

We recommend thus that the present CORE system design concept study be redirected to formulate a set of requirements and a development plan for CORE systems to aid the transition to Brand X. Such a requirement study and plan should define the portions of CORE systems which will be implemented by a standard off-the-shelf vendor supplied software and the portion of CORE systems which will not. For the portion that will not be implemented through off-the-shelf vendor supplied software the plan should formulate a series of staging development activities aimed at bringing such portions of the CORE software into a transportable implementation.

To clarify further what we are talking about let us look at something like MUM. First the determination should be made that the likelihood of having the same functionality from many of the standard industrial vendors is low and consequently that MUM would have to be transitioned to Brand X. After having made such a determination one should examine the present implementation of MUM and decide whether or not it is intrinsically transportable to most other vendor environments. If it is not one should schedule a

reimplementation of MUM in suitable language and system conventions to guarantee its portability to a Brand X environment.

A good example of this policy of staging towards a greater reliance on the resources offered by the industry, is given by the potential policy with regard to report writers. As we understand it the present policy is to maintain a home grown report writer. We believe that this policy is not very satisfactory from at least two respects. One is that it ties up precious in-house development resources, the other is that a single report writer cannot really span the wide interests and priorities of multiple user communities.

The present industry situation with regard to report writers that are capable of interfacing with the TOTAL DBMS is that there are several with different focus and optimization. For instance Easytrieve is optimized for casual inquiry, Mark IV is optimized for formal reporting, besides these two one should consider also Culprit and Socrates.

We thus recommend that, in line with: saving of internal development resources, easier staging to Brand X and satisfying in a better way the user communities, AIS consider the adoption of a policy of having multiple report writers commonly marketed in the industry and capable of interfacing with the TOTAL DBMS.

Both during the presentations of the CORE system program and those of the U&QC function the topic of dedicated initiators came up. A scheduling policy based on the use of dedicated initiators, controlling partitions dedicated to particular users of the AIS system, leads to potential under utilization of the mainframe computer resources. On the other hand such a policy can be a wise policy in the initial phases of an integration in so far that it can give a guarantee of priority control to a specific user community.

In light of the two above considerations we recommend that AIS pursue the development of a general purpose resource allocator for its mainframe facility, and that the individual cases of dedicated initiator be reviewed periodically (at least once every six months) at the OP-16 staff level to determine whether continuation of such privelege is still warranted. These reviews should generate a trend towards the elimination of such special handling of resource allocation over a period of time. Thus, a more efficient utilization of computer resources will result without any traumatic impact on user communities.

APPENDIX A

Comments on the Randolph AFB Visit

On Behalf of Bupers

Comments on the Randolph, AFB Visit on Behalf of Bupers

Introduction

On July 11 and 12, 1978 a team composed of Mr. W. Poteat and J. Kramer of Bupers, and U. O. Gagliardi of GSG, Inc. visited the Randolph Air Force Base to talk to the special project group of MPC. The purpose of the visit was to obtain information regarding a conceptual effort underway at MPC. The effort is concerned with potential technology directions and system development directions for the evolution of the Headquarter Air Force (HAF) personnel system.

This effort had been brought to the attention of Bupers management by Lt. Col. Thomas Lee as of potential interest and relevance to the Bupers AIS effort. Thus, one of the charges of our team was to determine whether such interest was indeed justified.

In Randolph we were exposed to a number of briefings that clearly conveyed to us the purpose, objectives, and nature of the activities of the special project. It became very clear that this special project is not, and should not, be considered a development project since it is a conceptual exploration of possible directions. We will amplify on this point in these notes.

The departure point for the effort was an extensive and critical review of the current status and structure of th HAF system.

HAF is one of three interacting levels of systems that the personnel arm of the Air Force uses for the management of personnel resources. The other two levels of systems are the Base level systems (BLPS) which is deployed as about a hundred twenty bases and the MAJCOM system which is deployed at about a dozen or so of major commands. MPC views the three levels of systems as an integrated system, vertically integrated system, where transactions originated from one level of system can flow to another level of system causing update and synchronization of information.

The critical review was concerned, as we understand it, with only the top level system, namely the headquarter system (HAF).

The result of the critical review can be briefly summarized as follows:

1. HAF consists of a core (which accounts for about 40% of the total system) and a very large number of subsystems. The core is driven by design concepts which are very similar to those of BLPS. Most important aspect of that similarity is the extensive adoption of table driven concepts for the implementation of the application (functional) software.

2. The numerous HAF subsystems are characterized by being basically unrelated subsystems, implemented in ad hoc fashion, to respond rapidly to pressing requirements.

3. HAF does not use modern database technology. It is based on the use of traditional flat files, in the form of nine Master Personnel Files and many hundreds of special files, most of which are really extracts from the MPF's. The fact that so many MPF's extracts are used causes serious problems with the concurrency of the information.

The overall assessment of the review is that: a) 60% and growing percentage of HAF is ad hoc, unrelated subsystems, developed under no common guiding architectural principles. b) only the core of HAF is table driven. c) the complex collection of files (many specific to one of these subsystems) whose contents have to be derived from the Master files presents increasingly serious problems to the maintenance of the total system.

The critical review study comes to the conclusion that many of the operationally apparent problems with HAF are only symptons of the more fundamental problems stated above and that until they are solved the symptoms of course will not disappear.

This study concludes that treating each symptom separately, by local modifications to the existent system, would not be effective and would be dispersive of energy. Consequently, what is needed is a redo of the system, that would permit the integration of several modern technologies, and the adoption of a clean base which would solve all of the problems in a permanent way.

Due to the rapid evolution of computer technology in the areas of hardware capabilities, programming techniques, data management techniques, and architectural design techniques it is always true, from a purely technical point of view, that the best solution is to start from scratch and design from what are currently correct principles. So we have no real qualms with the conclusion reached by the study. The reason, why many organizstions do not do it, is that they have the pressure to solve immediate problems and not enough discretionary resources to allow a calm and sheltered design along modern technological directions.

In other words, if an organization is not in a position to have a modest but highly qualified set of resources for a feasibility and first rough prototyping effort, it should not undertake it, because undertaking radical redesign activities in connection with the commitment to replace and supplant on going systems never works.

The reason why it does not work is that the pressures to decrease development risks are so high that automatically one is driven towards minimizing the amount of technological innovation permitted in the project.

The Personnel Machine

After completing the critical review of HAF the special project addressed the issue of formulating an alternative for it. This alternative is called the Personnel Machine.

The basic notion behind the personnel machine is to maintain and enlarge the previous thrusts of systems such as BLPS and HAF core in the direction of a highly responsive flexible system design for personnel applications. This is viewed as achievable via the integration of a number of technologies which did not exist at the time that BLPS and HAF were first designed and implemented. The specific technologies whose integration is cotemplated are:

1. Modern system implementation programming languages, namely the technology of transportable software for system level software, as reflected by such languages as PASCAL and DOD1 (which is PASCAL based).

2. The technology, that has evolved over the last decade, of modularization and stratification of operating systems, namely the generalization of the virtual machine notions and the Dijkstra notions.

3. The integrated database technology, whose major significance is the more complete separation of data and procedures and the ability to represent complex relationships amongst data in a program or procedure independent way.

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experience and it seems only right that it be folded into an integration of new technologies effort. In particular, the DLT's are not inconsistent with any of the other above notions so we do not see any problems with factoring this into the overall plan.

Point 5 is where the project shows in our opinion the greatest amount of technological innovation, in fact the state-of-the art is that notions of datatyping and data description, which are particular to the modern programming languages such as PASCAL, have not really been related with similar notions in database data management technology. Point 5 is precisly the integration of these similar but yet distinct notions. In other words, in this area we believe that the project will actually do a certain amount of applied research and tackling of not fully understood or fully known issues. However, we are confident that this is a necessary and potentially very useful integration to accomplish.

To better understand the significance of integrating the four technologies listed above it is well to remember the nature of the fundamental architectural tradeoff. This tradeoff is a tradeoff between the modifiability of the system and its efficient use of computer resources. In general, choices can be made either in the direction of increasing computer resources utilization or in the direction of increasing the ease with which the system can be modified, adapted expanded, etc., but not both simulataneously.

The history of computer technology can be viewed as a progression towards increasingly favoring the modifiability aspect over the efficiency aspect. The reason why computer technology has been moving in this direction are: a) the rapidly decreasing costs of computer resources warrants less and less preoccupation with their efficient utilization, b) the advance of Computer Sciences has improved the understanding of a number of modularity and separation of interface and similar other concepts, that while having a price in terms of efficient use of computer resources, greatly simplify the process of building a system, and consequently modifying it too, c) there has been a growing realization that EDP is not an end to itself, but it is a service function and consequently, from an economic point of view, one should be concerned not with the efficient utilization of computer resources, but rather with the efficient utilization of the operational resources.

The reason why we are mentioning this basic notion of computer technology is that the four technologies, mentioned above, and their integration move in the direction of increasing modularity and consequently modifiability, extendability, adaptability of the computing system. They all have built in some costs in terms of efficiency of computer resources. So, that to say that one would undertake a radical reorientation of the system design along the lines mentioned above means that one is seeking a very significant increase of modifiability, adaptability,

and exapandability of the system at the expense of some reduction of computer resource utilization. We believe that this is indeed the right direction to go, especially in systems designed for personnel functions.

Another historical perspective, that is worth keeping in mind in evaluating this special project, is that the application of computers started with the mechanization of accounting cost control type of applications and moved on to the inventory control type of applications where the field of applications is much less variable and dynamic than personnel. Later computer applications went into the personnel area. There is a fundamental difference between the personnel applications and say the accounting applications. Consider, for example, the case of legislative (madated) changes to the EDP system. In the case of accounting systems changes to accounting rules or accounting policy are rare and therefore, they materialize at intervals which are long enough to accomodate ponderous change mechanisms. In the case of personnel, mandated changes are very very frequent, especially in the last few years there has been a veritable explosion of legislation in the area of personnel benefits, taxes, retirement policies, etc. It is thus very clear that personnel systems should be designed with a system philosophy which is different than that for accounting systems. This was recognized by MPC even at the time of BLPS and HAF, and the special project is simply further accentuating such a trend.

Significance to Bupers

We now turn to the question of what does this all mean to Bupers and the AIS project.

The Advance Information System (AIS) development at Bupers is in response to an urgent need of the Navy to move its personnel support systems from a batch oriented type of philosophy t an interactive computing philosophy. In other words, the Navy has been engaged in the last few years into a system development that would allow terminals to be put into the functional users offices for the direct use by the personnel clerks to perform personnel actions such as assignments, etc. In connection with this effort, Bupers has also undertaken the introduction of modern database technology as the underpinning of the data management of the new system.

To put this Navy effort in perspective, one must realize that, except for the different data management technologies involved, from the functional point of view the Bupers effort is equivalent to the effort that the Air Force undertook about a decade ago with the introduction of BLPS and later on HAF. So, in our opinion the Navy is basically in urgent catch up mode, not so much to catch up with computer technology, as to use a minimum amount of new computer technology that would allow a significant and drastic revolution of the way the personnel clerks operate in their job.

The point is that the Navy objectives, at this point in time, and those of the Air Force are different. The Navy has an urgent need to catch up with the Air Force, in terms of achieving a more capillary dispersion of computer support to its staff so to achieve more efficient personnel operation and a reduction of the human resources dedicated to such processes. This is so that a better control be gained of the personnel inventory. The Air Force, by and large, has already achieved it for a number of years so the Air Force goal, at this point, should not be the rapid implemention of an operational system, but rather the goal is to ask questions about what are the directions along which further progress can be made.

So, one obvious consequence of this is that the two timetables are not compatible. The Navy requires technologies and system designs that can be brought on stream very rapidly, like in the next two years. The special project, although its notions, especially technological are excellent, will not have a chance to make a real contribution to the present AIS effort because it could not possibly contribute within the next couple of years.

This is not to say that the Navy should ignore the project completely. It would be a mistake to consider it a project that could make a contribution on a short term and should not be viewed that way. However, in the long term, in the five to ten year type of range, this project could make some very very significant contributions to both the Air Force and the Navy personnel systems. So, the conclusion we reach is that the Navy should do no more than monitor this project and its tech-

nological evalution. In our opinion, this monitoring could be effective if, at least one Navy person would participate, for at least a year, with the special project team. This person should have proper qualifications, that means that he should be a recent graduate from a Computer Science program, a Ph.D. in Computer Sciences would be the best choice for a Navy participant in the special project team.

In closing, we recommend that the Navy send a recent Ph.D. in Computer Sciences for a period of a year to be a fully participating member of the special project team at Randolph AFB, and that the Navy does not consider this project as a development project capable of producing outputs that could be factored into the AIS plan in the next two or three years. The latter would be a serious mistake that would result in confusion and harm to both the Navy and the Air Force. On the other hand, the full participation and monitoring of the technological aspects of this special project, we think would be a minor investment that would be well justified in terms of preparing the Navy to undertake, five to ten years from now, the further evolution of AIS.

APPENDIX B

Review of the AIS Program

"REVIEW OF THE AIS PROGRAM"

Prepared For

Bureau of Naval Personnel

OP-16

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1.0 Management Summary

This report presents the findings of the GSG review of the AIS Project held on December 12 and 13, 1978.

In this summary we will cover only those findings which require for their resolution the involvement of management higher then OP-16. The body of the report contains numerous additional issues which can be resolved internally to OP-16, the data processing development and operation organization of the Bureau of Personnel.

Section 3 (Organizational Issues) presents a single issue worth noting in this summary namely the difused nature of the Decision Support System charter (see Section 3.4).

Decision Support System (DSS) is the branch of OP-16 that is in charge of developing models in support of the planning and programming activities of the Bureau. The diffused charter arises from the need to preserve most of the development resources within the functional user organizations. Namely, about 90% of all development resources in this area are really in the hands of the ultimate users. This, as we stated, is a necessity given the nature of the work, however, has its negative consequences.

A negative consequence is that, at least for some of the programs, in particular NAMPS, we see a lack of accountability and a lack of management focus. To remedy this situation

we recommend that at the OP-01 staff level steps be taken to grant to the head of DSS the power to veto, or at least concurrence, with the expenditure of funds and personnel resources on DSS projects.

In Section 4 (Management Mechanisms) there are two issues worth noting. The first one has to do with the present structure of the various plans that control the AIS development (see Sections 4.4 and 4.5). The second one has to do with the tracking actual benefits realized by AIS applications and systems (see Section 4.3).

The first issue can be best presented by giving our recommendation which is that all of the plans that control the AIS development should be organized in a strictly hierarchical structure. That is it should be perfectly clear which of two plans is the controlling plan. With the controlling plan of course overriding any contradictions stated by the subordinate plan.

We further recommend that the following hierarchy be adopted:

- MANTRAPERS Plan
- AIS Strategic Plan (which should include the architectural plan and the financial plan)
- Program Plans
- Project Plan

Furthermore, it is essential that the MANTRAPERS Plan be completed as readily as possible to a level of articulation that spells out action level recommendations in addition to the present specification of objectives and policies.

The second significant issue (see Section 4.3) is the tracking of benefits realized by ADP applications. At first sight it may appear that such tracking is very difficult to do, however, a moment of reflection shows that such difficulty is more apparent than real.

The key concept is that benefits must be defined, at the proposal stage (ADS), so that they can be measured and therefore tracked. That is, a proposal should be approved only if its cost/benefit analysis includes only those benefits which the organization is capable of measuring. Thus, our recommendation in this area is very simply:

Do not accept, as part of a cost/benefit analysis, benefits which the organization cannot, or does not know how, to measure. Furthermore, adopt the practice of periodically reviewing benefit projected and benefit realized after the ADP application has gone operational.

Section 4 of the report (resources) has a number of noteworthy issues which we will present below.

Probably the most fundamental issue is the chronic lack of resources, that is personnel resources. Over the years that we have reviewed AIS and its predecessor developments, this has been a constant issue. In this report we are assuming that in the foreseeable future no additional people will be made available to the AIS development and consequently we are shaping our recommendations to confront this reality. Our key recommendation is as follows:

Move towards a personnel mix with a higher level of skills and therefore a higher percentage participation of higher grade positions. This should enable the organization to be able to rely more extensively on contracting and therefore to use fewer billets.

During the review information was supplied to us indicating that the percentage of higher grade (GS-13, GS-14, GS-15) in OP-16 and NMPC-16 is below the average for Navy ADP organizations. Such statistics would indicate that the above recommendation is a very realistic one and in fact that Bupers might be facing a serious problem in this area.

In addition to the above major recommendation we have the following subordinate recommendations:

- Get more personnel prepared and trained in the skills required in controlling/monitoring contracts.

- Contract for products/services instead of bodies.

- Contract out the inner part of the system and do in-house the outer parts of the system.

  The present practice is just the opposite of what we are recommending, although the OP-16 organization is moving in the direction that we are recommending. The basic rationale for our recommendation is that the inner part of the system are more universally valid and tend to be less directly impacted by mission related requirements. The opposite is true of course for the outer parts of the system.

A very important and crucial issue is the question of the classification of the OP-16 director billet. As the GAO report has recommended, the OP-16 director billet should be a civilan billet to insure the continuity of the leadership in this function. Continuity of leadership in information system development is an absolute must since development times are easily of the order of several years, especially when fundamental technological transitions are being performed such as in the case of AIS.

We strongly believe that the director of OP-16 has to have the stature to be on equal footing with the Admirals that head up the various subdivisions of OP-01, this means that such a civilian should be of the stature which in private industry would be considered Vice-Presidential level. That in turn implies that a super grade classification GS-16/17 should be obtained for this billet. Failure to obtain a super grade classification will result in an inability to secure the proper kind of management talent with very serious consequences to the AIS program.

During the review we obtained evidence indicating very serious classification problems with two development branches of the MNPC-16 organization. The branches in question are the MIS, which is responsible for the development of application systems supporting all of the major operational processes of Bupers.

The other branch is CORE which is responsible for the development of foundation system software. We believe that the classification problems are arising because the classifiers are having difficulty in grasping the fact that design talent and design ability which is present at the OP-16 level, in the office of the System Architect, is complimentary and not a replacement of the design talent that has to exist at the development branch level such as MIS and CORE.

We therefore recommend that a renewed approach be attempted to the classifiers to obtain the proper classification in higher grades for the management positions in these critical development branches.

The final and very critical issue in the area of resources is the lack of committed funding for the Brand X procurement. As we understand it, the Brand X procurement, in order to be compatible with predominant procurement doctrine for EDP systems, will have to expend the following sums of money, $3 million in 1980, $7 million in 1981, $8 million in 1982, $7 million in 1983, and $4 million in 1984 for a total of $29 million. Again as we understand it, this funding has been submitted in one of the POM's but it is at the bottom of the priority list with no guarantee that it will be authorized.

A complimentary issue is that of whether or not the Brand X procurement should be pursued by accepting the constraint of IBM compatibility.

The issue in question is that, if a constraint of IBM compatibility is authorized, then the procurement would still be competitive. In fact the nature of the industry is such that IBM compatibility now-a-days still implies multiple suppliers available, however one would avoid a very complex and expensive conversion benchmark exercise and therefore reduce the monies required by the procurement. It is our guess estimate that IBM compatibility would reduce the cost of the Brand X procurement by something like $20 million.

In light of the two above issues we recommend the following:

- The Programming and Plans function of OP-16 should periodically (at least once every six months) test whether or not the higher monitoring authorities would grant permission to use IBM compatibility as a constraint to the procurement. P&P should have the support of higher management in Bupers and the Navy in general since this action would save considerable monies and noticeably reduce the technical risk of the procurement.

- At the level of OP-01 and the ASN (FM) the funding situation of Brand X should be firmed up and clarified.

Section 6 of the report (Development/Technical Issues/Status) presents three issues which are worth the attention of higher management.

Both in order to move to a Brand X machine, and in light of our recommendation to start relying on industry sources for the inner part of the system, the development policy in the area of CORE systems should be carefully thought out. The purpose of such careful re-thinking should be to maximize the ability of the Bureau to utilize standard off-the-shelf software and to correspondingly curtail the activities leading to homegrown system software. Consequently we are recommending that (see Section 6.2):

The CORE system design concept effort presently underway, be redirected to yield requirements (for evaluation purposes) and a development plan supporting the transition to Brand X (staging to Brand X). Such a development plan should clearly segregate the portions of the CORE software that can be implemented by off-the-shelf industry offerings from those portions which cannot be replaced by off-the-shelf industry offerings.

For the latter part of the software the development plan should spell out specific development activities aimed at transforming the software into transportable implementations. That is the development plan should offer guidance on how homegrown system software will be staged into a transportable form that would allow it to be bootstrapped onto Brand X when Brand X is available.

The second development issue refers to the SDS project which is the foundation for the Pay and Personnel (see Section 6.3) consolidation project, PASS. The issue is that, because of procedural and data entry differences, at present three SDS's are emerging; a military, a civilian, and reserve versions. While we recognize that some of the differences are justified we believe that it is very important that an effort be made to prevent the evolution of three separate SDS's, therefore we recommend:

Formally document all of those differences in the military, civilian, reserve application which demonstratedly have heavy procedural impact on the user.

The rationale for our recommendation is that the very effort of formally documenting such differences will involve the separate functional users and will put the spotlight on the differences forcing an automatic reduction of such differences. In addition, once they are all formally documented it will be possible to hold an independent review and resolution of additional differences. We believe that this effort will result into the ability to implement a single SDS which will have a limited number customizations for the military, civilian, reserve cases.

The final development issue we would like to mention is the continuing evidence that the turnaround of application development is poor. (See Section 6.3.) What we are talking about is that the

ultimate user sees a rather long period of time between the formulation of a request for a new ADP application and the actual application coming on stream. To solve this problem we recommend the following:

Adopt a policy that no application ADP project be approved that is not capable of committing a first release operational capability to the user 18 months or sooner after the finalization of agreed upon functional requirements. Alternatively the policy could require that a first release of an operational capability be committed by the 24 month from the start of the project where the 24 months period would include also the finalization of functional requirements.

There is increasing evidence that shows that this policy is not only desireable but is entirely feasible.

Our final recommendation is concerned with the area treated in Section 7 of the report (User Interface) and is as follows:

In future reviews representative of the OP-1X using communities should brief the GSG team on a recent user acceptance experience.

The rationale for this recommendation is that it will give the GSG team an opportunity to see a more balanced presentation of the activities of AIS by obtaining first hand feedback from the users of their experiences with the AIS products and services.

We would like to close this management summary by stressing that, while the above put the spotlight on issues and unresolved problems, we were very favorably impressed by the speed and depth with which OP-16 has grown into the recently adopted organization. This new organization reflects extensive industrial practice and recent insights regarding the software development process. We were also impressed by the extent with which the first goal of the AIS development, the consolidation of the computing resources, has been achieved essentially on time. Finally, the breadth and the quality of the presentations given to us, and the openness of the discussions was extremely refreshing and a positive indicator that OP-16 is moving confidently on with the job at hand.

2.0 Introduction

This report documents the findings of the review of the Advanced Information System (AIS) Program at Bupers. The review was conducted by GSG, Inc. on December 12 and 13, 1978.

The findings of the review are organized in five sections as follows:

- Section 3 - Organizational Issues will report the findings regarding the practical implementation of the charters of the various suborganizations within OP-16.
- Section 4 - Management Mechanisms will report findings relating to mechanisms for the control of the processes and the resources of OP-16.
- Section 5 - Resources will discuss issues relating to various resources that OP-16 employs for its mission.
- Section 6 - Development/Technical Issues/Status will report all of the issues which have to do with the development process itself.
- Section 7 - User Interface will document issues that have to do with the effectiveness with which OP-16 relates to the user community.

In occasion of this review GSG received two major impressions which we would like to report in this introduction. The first is that we are very pleased with the considerable progress that has been made by OP-16 in adopting and implementing the organizational ideas and processes which were formulated at the Fort Richie Retreat in the Summer of '77. We believe that now OP-16 has the kind of organizational structure that is required for the successful undertaking of an ambitious project such as AIS. During the review we had plenty of opportunity to witness how the managers have identified with their role in the new structure, although there are still problems, there is no question that, overall, the new structure has taken hold of the organization.

The second key impression relates to the degree and quality of preparation for the review. There is no question that tnis review was the best we have attended at Bupers. The program was well laid out, the individual managers had done considerable effort in preparing concise presentations. The review had a clear overall theme. In other words, a truly professional job was accomplished.

3.0 Organizational Issues

3.1 PCO Role

The first item we would like to discuss is the role of the Program Control Office (PCO). The role of this office is to be delicately balanced in such a manner as to avoid the fundamental problem of a tree structured organization without demotivating the line managers.

The only human organizations that work are tree structured organizations. In fact, only for such organizations responsibility can be properly delegated by retaining accountability. However, tree structured organizations do not lend themselves very well to the development of information systems since not always is it possible to partition the system into a tree structure. As a result one always ends up with development projects which will span across the responsibility and accountability boundaries of the development line managers. It is for these reasons that a PCO office is needed to guarantee that those issues that go across the boundaries of the line managers are not neglected or not suboptimized by the individual managers.

If the PCO on the other hand becomes a second guessing tool in support of higher management, it is perceived as a form of restricted or subordinate delegation and therefore it can be extremely demotivating. We recommend, therefore, that the

PCO be carefully restricted to track those projects, such as SDS, which will span across several line managers (in the case of SDS for instance CORE and MIS are both involved). The general rule should be that if an issue is clearly under the responsibility of one of the line program managers then the PCO should have no involvement with it except maybe to stay informed of the status.

3.2 Project Tracking

Another important issue is where project tracking belongs. Possibilities are the Plan and Program (P&P) function, the PCO, the line program managers (PM's).

First of all there are two kinds of tracking processes involved. One is the purely job cost accounting tracking which will track actual expenditure versus the development plans supporting budget authorizations. The second kind of tracking tracks the actual degree of completion of the project versus development plans.

The financial tracking should be part of the P&P function which is the responsible agent for synthesizing the budget submissions and consequently would be the best place where to track the actual expenditure of financial resources.

The physical completion track has two separate issues. The first issue is the method with which such a track could be achieved. We will not discuss this in this report, however, we plan to at a later date give some input on this issue. It suffices to say that the issue of obtaining a reliable physical completion track for information systems is not a trivial one. Assuming that such an issue has been solved and the tools are on hand to perform such a track the question is then should the PM do it or should the PCO do it.

Our answer to the last question is that for projects which are entirely under the responsibility of the PM the PM should perform the actual tracking process. However, the PM should make the tracking information available for information only to the PCO office upon request from the PCO office. The only tracking that should be performed by the PCO office is tracking of physical completion of projects that involve more than one PM.

3.3 CORE Project Initiation

The fact that the CORE project initiation policy has not been completed is a disturbing indicator. We interpret this indicator to be a sign that the relative charters of System Architecture and CORE systems have not been sufficiently clarified or accepted by the corresponding managers.

We also understand that lack of time and an unresolved difference of opinion with P&P regarding the need for an economic analysis are the extant reasons for this policy not being ready.

Our experience shows that economic analyses are difficult if not impossible for CORE systems and that the alternative is to rely on the system architect to provide objective justification for CORE systems projects. In fact, most of the objective justification of such projects lies in the rationalization of the overall system architecture. The latter in turn is a strong supporting element of the cost/effectiveness of ADP applications.

As we see it the System Architect role is to act for CORE in the same manner as P&P acts for the application programs and products. Namely, the System Architect should distill, condense and abstract the requirements that are levied by the application

systems against the CORE system and it should be able to formulate a set of abstracted functional requirements for CORE systems. Furthermore, the System Architect office should be able to lay out an architectural plan that would indicate over the long term how the CORE system facilities hardware and software would evolve.

3.4 DSS Charter

The DSS charter, because of the special nature of the modelling work, has still a rather diffused nature to it. For instance, of about 200 people who are involved in modelling activities, only about 25 report directly to the DSS PM. This makes for a situation where OP-16 and the DSS PM do not have sufficient control on DSS-like activities. Another indicator of this lack of control is that the single largest project NAMPS, which by itself accounts for about half of the total resources in the DSS area, appears to not have a sharp focal point of management.

Our recommendation to improve the situation is to secure an authorization power for the DSS PM on the resource expenditure of all DSS projects. In other words, what we are saying is that we fully realize that many DSS projects, in order to be successful, will have to be done within the user structure. However, one should at least insist that the DSS PM has a concurrence veto on whether resource expenditure is allowed or not for a specific DSS project.

Another small problem with the DSS charter is that it appears that some MIS work is still, because of historical reasons, in the collections of projects overseen by DSS. We recommend that a plan for gradual transfer of the MIS work to the MIS branch be formulated.

3.5 Training

An important charter issue is where the training of new OP-16 and NMPC-16 employees should be performed. The present OP-16 policies indicate that training is performed by the System Architect office.

In industry one sees two kinds of solutions with regard to training. A centralized solution versus a decentralized solution. If the centralized solution is adopted usually training is done by the System Architect office since this is the corporate resource which has the most technical background of what is going on in the development shops and it also has always the charter for following and tracking developing technologies. In the decentralized solution training is delegated to the organization which will actually absorb the new recruit. Like many organizational issues there are pros and cons to both forms of training. The basic tradeoff is that decentralized training is faster, however, the employee starts with a parochial view of the organization and its activities and therefore has a lower capability of being reutilized in other suborganizations.

Exactly the converse is true in the case of centralized training.

Elsewhere we recommend that OP-16 consciously adopt policies aiming at reducing its staff numbers but increasing the representation of high skill levels in its job mix. The resulting

environment of job content enrichment is more compatible with training performed at the corporate level, thus we recommend that training be left with the System Architect office.

4.0 Management Mechanisms

4.1 QA Mechanisms

The notions presented to us by the U&QC function regarding quality control are not acceptable. The basic notion is a very ambitious and very expensive program for tracking down and mapping the consistency of multiple levels of technical documentation with assistance of a contractor. This is not necessary. It is expensive and it will totally demotivate the development groups who are producing this technical documentation.

Traditionally quality control is performed by an independent organization that reports to the head of the data processing organization and limits its determination of quality to an external view. The key concept is that the head of the data processing organization has to have an independent input in making the decision to release the product to the field. This independent view point comes from a Quality Assurance or Quality Control organization which tests the product strictly from a user point of view, that is the black box point of view, without having any understanding of its internals and its mode of operation. Vast industrial experience shows that Quality Control that is done with the absence of inside knowledge of how the product works is much more likely to simulate realistically the kind of abuse and mistakes that users will make in using the product. So the general concept, that is widely accepted in the industry, is that QA is performed

by starting from the user manuals with a staff of people, who know nothing about the product except what is in the user manuals, and they try to use it as specified by the user manuals and report whatever discrepancies exist. This approach to QA results in quality controlling not only the software and the hardware but also the user manuals.

We strongly recommend that U&QC limit itself to this traditional type of Quality Control.

4.2 User Acceptance Testing

During the discussions held at the review the issue of user acceptance also came up. It should be understood that user acceptance testing is different from Quality Control. Usually user acceptance testing is negotiated at the time the development project is authorized or during the early stages of the development project with the user specifying the kind of tests that he would like to perform for his own acceptance. Another important point is that user acceptance testing occurs after QA is finished. That is, QA determines whether the product can be released to the users in the first place. After the product is released to the user, the user has the opportunity to accept it or reject it on the basis of has own testing. This testing is aimed at not only determining general quality of the software, but also primarily determine whether the software satisfies the functional specifications and performance specifications the user laid out in the original contract.

Since, in the case of the Bupers environment, the user does not actively participate as a contracting entity, one may want to adopt a slightly different approach. U&QC could be charged to cooperate with the user in assisting him in setting up its own acceptance testing procedure. But still the fundamental point is that the user acceptance tests should in some way be legimately formulated by the ultimate user.

4.3 Tracking Physical Completion and Realized Benefits

Management tracking mechanisms for tracking the degree of physical completion and benefits realized by a particular EDP project are presently absent. GSG will provide in future papers some guidance on suitable management tracking mechanisms for the physical completion of information processing projects.

As far as tracking actually realized benefits the issues is not so much of mechanisms as an issue of willingness. There are two basic problems that interfere with the willingness to do an actual track of benefits. One is the perception on the part of the user organization that if benefits are visibly documented that this may result in curtailment of resources. The other issue is that the benefits projected in the development plan are usually not formulated in a manner that allows quantification.

The first issue is usually a pseudo problem because in general the introduction of information processing systems does reduce the resource required to do the original work, however, the real impetus for their introduction is the fact that the work-load is escalating faster than the resource expansion rate would permit. So, we believe that this first problem can be overcome if in the projection of the benefits one would put the whole benefit picture in a realistic perspective, that is of showing actually how workload future expansion is coped with by the introduction of the information system.

The second issue, surprisingly enough, is actually resolved by a commitment to track realized benefits. That is, once a corporate willingness to track realized benefits is achieved then, at the time of approval of the project, there will be ample scrutiny of whether projected benefits are quantifiable and therefore trackable or not.

4.4 Relationship Between the AIS Plans

The relationship of the various AIS plans is represented in the strategic plan in a way which causes some concern. During the presentation it was explained to us that the graphical representation given for the relation between the various plans was for the purpose of indicating how they actually were being developed. The representation in question shows that the program plans the MANTRAPERS plan, and the strategic plan interact with each other in a kind of a close loop process. This of course illustrates well the iterative nature of these processes. However, it is very important to commit to a hierarchical relationship between these plans.

The correct hierarchical relationship between the plans should be as follows: the MANTRAPERS plan should be the dominating plan, below it the strategic plan should be the dominant AIS plan, the strategic plan should subsume the architectural plan and the financial plan, the strategic plan in turn should control all of the program plans and then finally the program plans should control the project plans. A higher hierarchical plan controls a lower plan in the sense that if a lower plan asserts anything which is in contradiction with the higher plan, the higher plan prevails.

4.5 MANTRAPERS Plan Improvement

Another problem with the plans is that the MANTRAPERS plan needs improvement in the direction of expressing concrete actions to be performed to fulfill the objectives presently expressed by the plan. This improvement has been called for by the GAO report and it is also needed in order to tie the AIS strategic plan to the MANTRAPERS plan.

4.6 Multi-Vendor Environment Control and Job Cost Accounting

Two other important management mechanisms which are still not articulated in OP-16 are: 1) mechanism for the control of a multi-vendor environment and 2) mechanism for doing complete job cost accounting for a structure where there are projects reporting to programs, programs reporting to organizational entities such as MIS, DSS, etc. and with cross reporting taking place at several levels of the hierarchy.

This is not the place to treat both of these subjects since they are quite complex. We will do so in future notes.

4.7 Approval of DPSR's

The final management mechanism issue is that of the control of the DPSR's. This issue is not new to us, in fact, we discussed it in the first couple of reviews of Bupers and its activities. We recommended at the time that a formal approval procedure be set up so that DPSR's which exceeded certain threshholds of effort would actually require explicit approval rather than being informally shoved into the queue of work to be done.

The motivation that we had in mind, at the time we recommended this, was that the bulk of the development resources of Bupers were in the PERS-3c organization doing maintenance and enhancement work of the current system with very little resources left for the predecessor of AIS (MAPMIS).

We believe that a formal procedure was evolved and adopted and as a result of that a considerable amount of PERS-3c resources were freed up and made available for the future MAPMIS project. Probably all that is required at this time is a review of the DPSR's approval procedure to see whether it is really still being followed and whether the threshholds that were set at the time are still adequate.

It might very well be that, since AIS has now overcome the conflicts between current system and AIS through a much more integrated approach to the organization and the development process, the threshholds that were set up at the time are much too high. The threshholds may be set up in such a way that DPSR's of something like a couple of dozen man months are still getting through without any formal approval other than that of the PM. It would be a simple matter to establish that any DPSR that exceeds 12 man months level of effort requires the approval of OP-16 or his designee in order to be committed.

5.0 Resources

Throughout all of the presentations the theme of lack of resources was a constant refrain. There is very little question in our mind, especially in view of the history of the last three years, that significantly larger personnel resources or dollar resources are not forthcoming and consequently the only constructive approach is to look at the deployment of current resources and see whether a shift of resource mix can get the job done.

This section of the report approaches the problem from the point of view that total number of billets is likely to stay constant or even decrease. In other words, the basic recommendation underlying everything we are going to say in this section is to move in the direction of an organization that has higher level of skills and consequently higher grades and is more capable of planning and defining work to be performed by outsiders, namely contractors. We believe that this is in line with general government policies.

On the issue of staffing we have the following recommendations:

a) Plan on evolving into an organization with fewer billets and people and a higher percentage of higher grade (GS-13, GS-14, GS-15) grades. Such a personnel stance would be much more supportive of activities such as the Brand X procurement and in general a heavier emphasis on control of contracts.

b) For continuity and stability increase the civilian component of the personnel mix in DSS.

c) We see serious classification problems in the CORE and MIS branches. We believe that these problems are due to the fact that the classifiers have had difficulty in grasping the relative role of the System Architect office and that of the CORE and MIS development groups.

These classification problems must be overcome and we would be glad to assist in any way possible to convince classifiers that the CORE and MIS positions are equally important than those of the System Architect.

d) We are completely convinced that the OP-16 director billet (in order to be filled by a civilian as is recommended by the GAO report) should be a super grade (GS-16 GS-17) billet. This is because the Director has to have a managerial stature comparable to that of the Admirals on OP-01 staff. That is he has to be of Vice-Presidential caliber.

We would like to address the issue of priority guidance for positions within the OP-16 organization. The way we will approach that is to give for each suborganization priorities for grades and for number of billets. That is, given a particular organization, which one of its own sub-organizations should have priority on the higher grade billets and which one should have priority on the number of billets.

OP-16: the priorities for the staff of OP-16 are, as we see it, as follows: priority for higher grades SA, P&P, PCO. Priority for number of billets, P&P, SA, PCO.

NMPC-16 priority for higher grades DSS, MIS, CORE, U&QC, FM. Priority for number of billets, MIS, CORE, DSS, U&QC, FM (assumes the facility management contract will be entered in). If such a contract is not entered in then the last priority structure should be revised to: FM, U&QC, MIS, CORE, and DSS.

MIS: Since we received no information from the director of the branch we will only give a priority indication based on projects as follows: NMDAS, SDS, officer order writing module, enhancements to enlisted men systems.

CORE: We have a single priority for both higher grades and number of billets as follows: distributed processing, data management, host processing.

For the System Architect office, for which we have detailed staffing information, the priority for both grades and number of billets would be, in our opinion: application integration, standards, support integration.

The other major resource issue is funding, namely, it appears that present budgets for the POM cycle 81 do have any allocations for the Brand X procurement but they are low priority items which may not receive authorization. The Brand X procurement it appears would require something like 3, 7, 8, 7, 4 million dollars respectively in 1980, 81, 82, 83 and 84 for a grand total of $29 million which appear not be allocated in the budgets for that time frame. The financial situation as we understand it could get worse, that is even the presently planned budgets could be further reduced by something like 10% in which case we understand the SDS project would be seriously delayed.

The fundamental message is that if the incremental funding of some $29 million is not made available over the period 1980 - 84 the Brand X procurement will not come to pass and that if there is a budget cut then the SDS project may be significantly delayed.

6.0 Development/Technical Issues/Status

In this section we will describe a number of issues and concerns related to the various development activities underway in the AIS program. For clarity of presentation the issues are segrated into a number of subsections. Subsection 6.1 will cover issues related to System Architecture, section 6.2 the issues related to CORE systems, section 6.3 MIS related and finally 6.4 miscellaneous issues. During the review no development issues surfaced with respect to DSS activities. This is primarily because the presentations that were made addressed issues of management mechanisms and status as opposed to the actual development.

6.1 System Architecture Issues

The November 21, 1978 draft of the AIS Architecture Plan, in intent, covers all of the important areas of architectural definition for AIS. That is the proposed table of content appears to us to be satisfactory. However, the draft is primarily an annotated table content, that is except for minor portions the plan is still a plan to do the plan. It is very important that the actual architectural plan be produced, at least in the preliminary draft form, as soon as possible.

In other words, we recommend that the present table of content be expanded very rapidly (in a matter of weeks), at least as a first pass and a discussion type of draft, since this will help in jelling a number of ideas very rapidly. It can also help in providing guidance to the DSS, MIS, CORE development processes.

The Brand X procurement is being approached at present from the perspective of complying with A-109. This implies that a procurement package which specifies mission related (functional) requirements would be presented to the industry in an open competition. Such an open competition is very likely to result in a number of participating competitors which are not in any way at all compatible with IBM machine architecture and system conventions. It follows that a very high risk for the transition of the AIS software onto the Brand X machine exists.

To protect the government from this high level of risk it has been decided that the approach that will be followed in the Brand X will include two benchmarks. One being the traditional benchmark for cost performance evaluation of the competitors, and the other being a transition benchmark. That is a selected group of application systems, which are mission critical and technically difficult to transition, would be transitioned by the vendors under a multiply funded transition contract.

This approach to the Brand X procurement is of course expensive and as we remarked in Section 5.0 Resources, there is a definite issue of the absence of the funding for such an approach. It is projected that in the years 1980 - 1984 the Brand X procurement following this approach would cost about $29 million. It can be anticipated that a procurement approach that would assume IBM compatibility would cost as much as $20 million.

Therefore the fundamental tradeoff for the Brand X procurement is, on one hand the $29 million additional costs, and of course the greater complexity and length of the procurement, and on the other hand the ability to truly have a completely open approach to the marketplace. During the review discussion the point was made that probably the AIS management should continuously test the assumption that IBM compatibility would not be allowed as a constraint of the procurement by higher monitoring authorities.

Although from our general experience of procurements of this sort, we do not believe that a variance to A-109 policy (formulation of IBM compatibility as a constraint to the procurement) will be permitted. We agree that P&P should periodically test whether or not a waiver for IBM compatibility can be obtained.

The reason to recommend this is that the nature of the industry is evolving very rapidly, and IBM compatibility does not any longer mean IBM products and neither does it mean a very restricted marketplace. In fact, the number of firms which are capable of offering look-alike and plug compatible replacements for increasing portions of the system, especially in the case of IBM systems, is growing very rapidly. Therefore, we think that it is only prudent management to make sure that, as more and more information is obtained on the costs and the risks of the fully open competitive approach, the procurement assumptions be revalidated with very top authorizing authorities.

Another important issue, in the area of system architecture, is the study of the various alternatives to SDS. This issue was precipitated by the GAO report which called for a study of alternative ways of distributing processing in support of SDS. We understand that we will receive shortly the study on alternatives and we will comment on that study upon receipt.

The operational experience accumulated thus far with the PRO system allows an evaluation of the PRO architecture. This evaluation was presented to us during the review and basically the results are that the PRO distributed architecture succeeds very well in off loading the central processor. In fact, a considerable number of terminals can be supported with absolutely negligible loading of the central processor. However, while from a performance point of view, the PRO architecture has proved out to be very effective there are serious misgivings with regard to its availability.

During the presentation there was considerable discussion on whether the availability problem arises from the Host, or the FEP, or the remote terminal processor, or the lines. As a result of the discussions we requested that some actual data be given to us with regard to scheduled time, available time, and down time for the three classes of processors namely Host, FEP, RTPC.

The data covers the four weeks of November 13, November 20, November 27, and December 4, and they are presented in Table 6-1.

	Scheduled Uptime	Host Available	Host Down	FEP Available	FEP Down	Mini RTPC Available	Mini RTPC Down
13NOV78	45.0	31.0	14.0	44.9	0.1	41.6	3.4
20NOV78	36.0	24.6	11.4	35.1	0.9	34.9	1.1
27NOV78	45.0	34.0	11.0	44.8	0.2	44.0	1.0
04DEC78	45.0	29.0	16.0	43.4	1.6	44.3	0.7
Totals	171.0	118.6	52.4	168.2	2.8	164.8	6.2
PERCENTAGE Scheduled Uptime ÷	100	69.3	30.6	98.3	1.7	96.3	3.6

Table 6-1

The data is extremely significant and again illustrates that a little bit of data can cut through endless hours of discussion. In fact, the data shows that the host was available during those four weeks for an average of 69.3% of scheduled time, the FEP was available during the same period for an average of 98.3% of scheduled time, and the RTPC was available over the same period for an average of 96.3% of scheduled time. From these figures it can be readily concluded that the lack of availability of PRO to the user is largely determined, if not exclusively determined, by the fact that the Host is down something like 30.6% of scheduled time. Therefore, the availability of PRO is not the consequence of its architecture.

Our recommendation is thus to carry an in-depth study of the causes of such an excessive down time for the Host. We also recommend that a management objective of gradually reducing the Host down time be set up. In addition, consideration should be given to increasing the amount of scheduled time so that overall user availability can be improved.

A final architectural issue is what should be the implementation language for the future of AIS. During the presentations of the CORE systems program the issue of implementation was raised, namely the desirability to have high level language alternatives to the use of assembly language (ALC).

Our recommendation in this area would be that, provided that the speed of compilation is not extremely crucial, and that on the other hand efficient object code is an important issue, AIS establish contact with various research groups in the country who are experienced with PASCAL and PASCAL transportability and bootstrapping mechanisms. We can assist AIS personnel in establishing these contacts.

The rationale for this recommendation is as follows:

a) We believe that the DoD-1 (now called ADS) initiative will succeed (over a number of years). DOD-1 is PASCAL derived, consequently a move towards PASCAL would be a staging move for an eventual adoption of DOD-1 by AIS.

b) Programming languages of modern type such as PASCAL, DoD-1 provide the tools for producing software which is not only structured but is also designed for modern notions of portability.

c) There are already a number of PASCAL compilers which are written in PASCAL therefore suitable for bootstrapping the compiler onto one's own machine.

6.2 CORE Systems Issues

The most important issues for the CORE systems area is that of the development strategy to be pursued in light of the Brand X procurement. Assuming the Brand X will proceed on the present course of a totally A-109 procurement, the planning of developments in the CORE system area is both very difficult and very critical to the success of the Brand X operation.

From the review we learned that an effort to formulate a CORE system design concept is presently underway. One of the very first questions is: to what use would such a design concept be put. The possible uses as we see them are:

a) As a blueprint for internal development to be pursued once the Brand X machine is available.

b) As a specification for the Brand X procurement.

c) As a means to supply in-depth technical evaluation material to be used during the Brand X proposal selection phase.

d) As a blue print for development to be performed after Brand X is known by either the original Brand X vendor or other contractors.

e) As a blueprint for both staging activities to be performed before the Brand X selection, and developments after the Brand X selection, by OP-16 people augmented by contractors.

It seems to us that alternative a) is largely to be excluded because the limited development resources are already completely applied to short term development goals. Alternative b) has to be excluded because it is contrary to the spirit and the letter of A-109. Alternative c), d), and e) are all of significant interest.

In the case of alternative c) the design concept for CORE systems could be a source of technical evaluation factors with great power of discrimination and selectivity. Since there is no question that after Brand X has been selected the evolution of CORE systems will have to continue, it follows that alternative d) will be of interest in guiding the further work of the Brand X vendor and associated contractors. However, the most interesting use of a design concept for CORE systems is really alternative e). This alternative really contemplates staging activities that could be performed before the Brand X is installed.

What we are referring to is that, while for the application systems the Brand X procurement concept will guarantee that they will transition correctly to Brand X, nothing of the kind is available for CORE systems.

Furthermore, to insist that a transition benchmark be used for CORE system as well as application systems could be construed as being contrary to predominant procurement doctrine and A-109. The reason why CORE systems cannot be incorporated in a transition benchmark is that it is very difficult, if not impossible to assert that CORE system functionality is directly related to mission requirements.

Since CORE systems cannot be incorporated in transition benchmark, the alternative is to stage the CORE systems so that equivalent functionality can be guaranteed after the transition.

We recommend thus that the present CORE system design concept study be redirected in the direction of formulating a set of requirements and a development plan for CORE systems to aid the transition to Brand X. Such a requirement study and plan should define the portions of CORE systems which will be implemented by a standard off-the-shelf vendor supplied software and the portion of CORE systems which will not. For the portion that will not be implemented through off-the-shelf vendor supplied software the plan should formulate a

series of staging development activities aimed at bringing such portions of the CORE software into a transportable implementation.

To clarify further what we are talking about let us look at something like MUM. First the determination should be made that the likelihood of having the same functionality from many of the standard industrial vendors is low and consequently that MUM would have to be transitioned to Brand X. After having made such a determination one should examine the present implementation of MUM and decide whether or not it is intrinsically transportable to most other vendor environments. If it is not one should schedule a reimplementation of MUM in suitable language and system conventions to guarantee its portability to a Brand X environment.

A good example of this policy of staging towards a greater reliance on the resources offered by the industry, is given by the potential policy with regard to report writers. As we understand it the present policy is to maintain a home grown report writer. We believe that this policy is not very satisfactory from at least two respects. One is that it ties up precious in-house development resources, the other is that a single report writer cannot really span the wide interests and priorities of multiple user communities.

The present industry situation with regard to report writers that are capable of interfacing with the TOTAL DBMS is that there are several with different focus and optimization. For instance Easytrieve is optimized for casual inquiry, Mark IV is optimized for formal reporting, besides these two one should consider also Culprit and Socrates.

We thus recommend that, in line with: saving of internal development resources, easier staging to Brand X, and satisfying in a better way the user communities, AIS consider the adoption of a policy of having multiple report writers commonly marketed in the industry and capable of interfacing with the TOTAL DBMS.

Both during the presentations of the CORE system program and those of the U&QC function the topic of dedicated initiators came up. A scheduling policy based on the use of dedicated initiators, controlling partitions dedicated to particular users of the AIS system, leads to potential under utilization of the mainframe computer resources. On the other hand such a policy can be a wise policy in the initial phases of an integration in so far that it can give a guarantee of priority control to a specific user community.

In light of the two above considerations we recommend that AIS pursue the development of a general purpose resource allocator for its mainframe facility, and that the individual cases of dedicated initiator be reviewed periodically (at least once every six months) at the OP-16 staff level to determine whether continuation of such privelege is still warranted. These reviews should generate a trend towards the elimination of such special handling of resource allocation over a period of time. Thus, a more efficient utilization of computer resources will result without any traumatic impact on user communities.

6.3 MIS Issues

During the presentations on SDS it became very apparent that present trends are that three separate SDS applications will evolve, they are: the military, the reserve, the civilian. Although unification in the source data area is a tough proposition and extreme unification is not necessarily a desireable goal, we still believe that the emergence of three separate SDS applications should be under some kind of scrutiny.

We recommend thus that the SDS development group document the nature of the discrepancies between the various SDS applications, namely difference in forms and procedures and that it attempts to isolate as many of these differences which are resolvable by negotiation with the users as possible, and clearly document those that because of alleged heavy procedural impact on the user cannot be so resolved.

By making this kind of effort one would increase the probability that frivolous and superficial differences between the three applications do not become institutionalized in the SDS implementation.

Another important issue in the MIS area is that, for a variety of reasons, the visibility of delivered applications to the user community has been and is poor. For instance,

in this review the following information was presented to us:

a) TOPS has not been implemented in October as per plan and is presently projected to be completed in the March/June 79 timeframe. This delay is primarily attributed to the need to shift resources away from TOPS to SDS and also to hardware problems.

b) NMDAS (formerly BFM) is now projecting completion in the Fall of 79. This is primarily due to hardware unavailability and the impact of integrating civilian positions into the BFM module and to staffing problems. Given the work still to be done we are somewhat skeptical that the Fall 79 deadline will be achieved.

c) The officer order writing system sees the development stretched out over three phases with respective dates of August 1980, August 1981, August 1982. We were told that this timing is driven by the user, namely, the OP-13 staff ability to accept the product.

All three of the above share one common characteristic, namely that the development time to complete an application is excessively long. This is certainly true of officer order writing which is planned for a span of over three years and of NMDAS which was under development three years ago when we first reviewed the then future MAPMIS project.

The extremely long development times for the MIS applications is contrasted on the other hand by fairly rapid advances in the CORE system area, at least in the last three years. This in turn is an indicator that the priorities are probably somewhat off-balance, since ultimately the best system software will get absolutely no credit unless applications which are truly visible to the users come into being and fully utilize the capabilities of the system software. Part of this delay, we understand from our previous reviews, was caused by the suspension of applications development pending the formulation of a MANTRAPERS plan and revamping of the AIS development plan from the old future MAPMIS plan. But even making allowance for these management redirections we believe there are still fundamental problems with regard to the way applications are being undertaken within AIS.

We would recommend that a policy be adopted that any application subsystem that is committed within the AIS framework be limited to have a first release, utilizable in true operational conditions, withing 18 months of start of the project. Insistence in such a policy is healthy for two reasons. First, it would guarantee that users see some concrete results within a reasonable time, secondly, it would force to head those situations where either the CORE system foundation is not adequate to support the proposed application or the conceptual formulation of the application, both in terms of its functionality and architecture, is basically unsound or overly complex.

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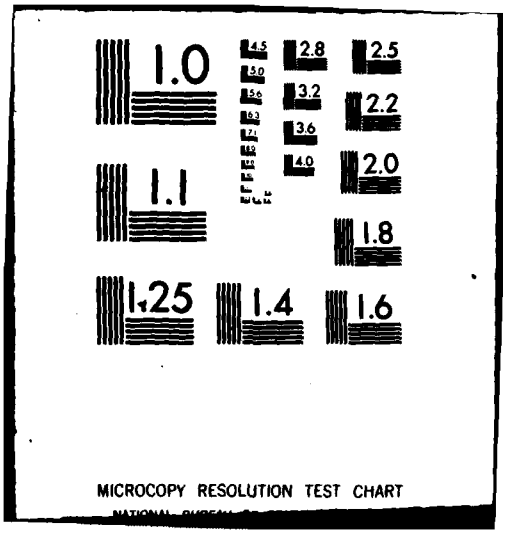
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What we are suggesting is a policy whereby MIS applications would have either a first concrete deliverable release to user within 24 months of the start of the project (or alternatively 18 months from the date of completion of functional requirements), or obtain a waiver, but this waiver would result only upon an in-depth review by both the System Architect and the P&P function with the waiver of course being released by OP-16.

Another benefit of this policy is that it would force a clarification of the perspective of the functional scope of an application system, such as NMDAS, and its implementation plan. Namely, the implementation plan could be formulated in terms of incremental implementations, the first of which would occur 24 months after the start or sooner. Subsequent implementations would then eventually drive towards the full implementation of the functional scope of the subsystem.

A final important point we wish to make with regard to the MIS activities is that this development group has a very key role in the success of the Brand X procurement. The point being that the chief components of the conversion benchmark are subsystems which are developed and maintained by MIS. It appears to us therefore that it is imperative that suitable participation of the MIS group into the Brand X activities is secured. This participation can be expected to be of a substantial level since, if our previous experience in similar conversions is a guide, it will be necessary to do a considerable

amount of work in documenting or improving the documentation of the elements of the conversion benchmark. What we are referring to is that it will be necessary to generate a transition or conversion library for the vendors to use. This generation of the transition library can only be performed by substantial participation of MIS personnel (whether contractors are used or not).

6.4 Miscellaneous

We believe that, as we stated above, an important evolution of the AIS development group is to move more and more in the direction of using an increasing share of contractor assist and therefore shifting away from direct development to more of a mode of contract formulation and contract monitoring. If this belief of ours is correct, then the present organizational know-how needs additional strengthening. We would recommend the following:

a) Take deliberate steps to get more personnel trained to properly control and monitor the activities of contractors. At present we know of only very few individuals which are fully qualified to monitor contracts.

b) Shift towards a mode of increasingly contracting for a definite product or service as opposed to contracting for bodies.

c) The present priorities are to contract out the parts of the system which are further away from the hardware. This is precisely the opposite from the general industry trend where subcontracting or vendor supplied off-the-shelf components are usually in the inner layers of the system, while the further out a component is, the more likely it is to be implemented in-house.

> The reason why the outer layers of the system should be done in-house is that the further out components of the system are they are the ones more intimately linked to mission specific knowledge. While the inner layers, being technically more challenging, are the ones that tend to be universally valid for various groups and applications.

A final and seemingly minor point is that the present version of the strategic plan uses the term goal as synonomous of a development process. The orginal AIS plan had Goal I, II, and III which were respectively defined as follows: Goal I was the consolidation of the computer facilities in a single location; Goal II was the implementation of SDS; Goal III was the installation and operation of Brand X.

In other words the original definitions of Goal I, II, and III was in terms of a tangible accomplishment that could be clearly measured and observed and therefore goals could be achieved. The present strategic plan is talking in terms of goals which are the process of continuing the evoluation and maintenance of the consolidated facility, the process of continued enhancement and evolution of SDS, etc.

The reason why this use of the term goal is poor is that, from a point of view of senior management, a goal is something that has to be accomplished at some definite point of time and it would be very harmful to the project to inadvertently convey the impression that goals are never achieved. While of course, it is very true that ADP development processes are never truly terminated. Thus, we recommend that the strategic plan in the next version be rewritten substituting the word goal with either product or service. In other words, we would be talking about the consolidated services rather than Goal I, the SDS product rather than Goal II, etc.

7.0 User Interface

In all of our previous reviews we have never really had an opportunity to look probingly into the interface between the AIS organization and its user communities. For instance, we can think of a number of key questions that AIS management should repeatedly pose and answer and to which we can give either no answer or a partial answer. Some of the most important questions are:

- Is the user getting more in 1978 than he was in 1975? What can he expect in 1981?
- Is there a committed user for data processing systems?
- Is the user more or less help to data processing?
- Has DP taken the time and effort to educate the user?

Since in all of the previous reviews of AIS we have rarely seen bonafide users, the following recommendation would improve our insight on how effective AIS is with respect to users.

We recommend that in future reviews a representative for each of the OP-1X, which are using communities of the OP-16 products and services, attend the reviews and brief the GSG team on a specific recent user acceptance experience with an OP-16 product or service.

On the very important issue of how application priorities are established, AIS has set up a consumer board which is chaired by OP-1X with the membership being the deputy in all of the OP-xx organizations other than OP-16. We understand that the consumer board does a preliminary stage of priority setting. We do not have information on the followup for this priority setting, and consequently how final priorities get established.

We believe that the key representation (represented by the deputy) of the functional managers on the consumer board is absolutely essential for guaranteeing its credibility and priority setting. We also believe that in order for the board to be effective suitable staff work be available to it so that thorny priority issues can be staffed and researched in preparation of the board achieving resolution. The other key factor, in making such a board a valuable mechanism, is to make sure that it does not just do the preliminary priority setting but that it has the ability to re-examine these priorities at periodic intervals, say every 6 months. First to verify that they are being reflected by the implementation plans of OP-16 and it has an opportunity to incrementally change them if the OP-01 environment so requires.

In addition to the above long term problems, we are particularly concerned about a special short term problem. The problem is that with the recent reorganization of the Bureau, functions which have been for many years separated, are formally unified, like for instance officer and enlisted men distribution. It would be very dangerous for OP-16 and AIS management to completely trust this functional reorganization to yield truly unified requirements. To avoid this very subtle danger we recommend the following:

- OP-13, military personnel, is to set up a mechanism for unified guidance to OP-16.

- P&P/PM to pay extra care on all of those user requirements and product packaging/delivery commitments which are made on behalf of users which have undergone a drastic reorganization within the recent reorganization of the Bureau.